CLAIMS

What is claimed is:

Claims 1-109 (cancelled)

110. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches, and n_1 inlet links for each of said r_1 input switches;

an output stage comprising r_2 output switches, and n_2 outlet links for each of said r_2 output switches; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link (hereinafter "first internal link") connected to each input switch for a total of at least r_1 first internal links, each middle switch further comprising at least one link (hereinafter "second internal link") connected to each output switch for a total of at least r_2 second internal links;

said network further is always capable of setting up said multicast connection by never changing path of an existing multicast connection, and the network is hereinafter "strictly nonblocking network", where m is a minimum of at least $2*n_1+n_2-1$.

111. (new): The network of claim 110 wherein each multicast connection from an inlet link passes through at most two middle switches, and said multicast connection further passes to a plurality of outlet links from said at most two middle switches.

112. (new): The network of claim 110 further comprising a controller coupled to each of said input, output and middle stages to set up said multicast connection.

113. (new): The network of claim 110 wherein said r_1 input switches and r_2 output switches are the same number of switches.

114. (new): The network of claim 110 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then m is a minimum of at least $3 * n - 1$.

115. (new): The network of claim 110,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

116. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, said method comprising:

receiving a multicast connection at said input stage;

fanning out said multicast connection in said input stage into at most two middle switches to set up said multicast connection to a plurality of output switches among said r_2 output switches, wherein said plurality of output switches are specified as destinations of said multicast connection, wherein first internal links from said input switch to said at most two middle switches and second internal links to said destinations from said at most two middles switches are available;

wherein said act of fanning out is performed without changing any existing connection to pass through another middle switch.

117. (new): The method of claim 116 wherein said act of fanning out is performed recursively.

118. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through

r_1 first internal links and each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, said method comprising:

checking if at least a first subset of destination output switches of said multicast connection have available second internal links to a first middle switch; and

checking if a second middle switch has available second internal links to a second subset of destination output switches of said multicast connection.

wherein each destination output switch of said multicast connection is one of said first subset of destination output switches and said second subset of destination output switches.

119. (new): The method of claim 118 further comprising:

checking if the input switch of said multicast connection has an available first internal link to said first middle switch and to said second middle switch.

120. (new): The method of claim 118 further comprising:

prior to said checkings, checking if all the destination output switches of said multicast connection are available at said first middle switch.

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121. (new): The method of claim 118 further comprising:

repeating said checkings of available second internal links to another second subset of destination output switches for each middle switch other than said first and said second middle switches.

wherein each destination output switch of said multicast connection is one of said first subset of destination output switches and said second subset of destination output switches.

122. (new): The method of claim 118 further comprising:

repeating said checkings of available second internal links to another first subset of destination output switches with each middle stage switch other than said first middle stage switch.

123. (new): The method of claim 118 further comprising:

repeating said checkings of available first internal link to each middle stage switch other than said first middle switch and said second middle switch.

124. (new): The method of claim 118 further comprising:

setting up each of said multicast connection from its said input switch to its said output switches through not more than two middle switches, selected by said checkings, by fanning out said multicast connection in its said input switch into not more than said two middle stage switches.

125. (new): The method of claim 118 wherein any of said acts of checking and setting up are performed recursively.

126. (new): A method of setting up a multicast connection through a three-stage network, said method comprising:

fanning out only one or two times in an initial stage,

and fanning out any number of times in each of the remaining stages,

wherein said three-stage network includes said remaining stages and said initial stage.

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127. (new): The method of claim 126 further comprising:

repeating said acts of fanning out with a plurality of portions of each of said stages.

128. (new): The method of claim 126 further comprising:

recursively performing said act of fanning out.

129. (new): The method of claim 126 wherein:

a remaining stage immediately following said initial stage comprises internal links that are at least two times the total number of inlet links of said initial stage.

130. (new): The method of claim 126 wherein:

said initial stage comprises a plurality of first switches, and a plurality of inlet links connected to each said first switch; and

a remaining stage immediately following said initial stage comprises a plurality of second switches, that are at least double the number of inlet links of each first switch and each second switch comprises a plurality of internal links at least equal in number to the number of first switches in said initial stage.

131. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to each output switch for a total of at least r_2 second internal links,

said network further is always capable of setting up said multicast connection by never changing path of an existing multicast connection, and the network is hereinafter "strictly nonblocking network", where m is a minimum of at least $3 * n_1 + n_2 - 1$.

132. (new): The network of claim 131 wherein each multicast connection from an inlet link passes through at most three middles switches, and said multicast connection further passes to a plurality of outlet links from said at most three middle switches.

133. (new): The network of claim 131 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

134. (new): The network of claim 131 wherein said r_1 input switches and r_2 output switches are the same number of switches.

135. (new): The network of claim 131 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then m is a minimum of at least $4 * n - 1$.

136. (new): The network of claim 131,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

137. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, said method comprising :

receiving a multicast connection at said input stage;

fanning out said multicast connection in said input stage into at most three middle switches to set up said multicast connection to a plurality of output switches among said r_2 output switches of said multicast connection, wherein said plurality of output switches are specified as destinations of said multicast connection, wherein first internal links from said input switch to said at most three middle switches and second internal links to said destinations from said at most three middle switches are available,

wherein said act of fanning out is performed without changing any existing connection to pass through another middle switch.

138. (new): The method of claim 137 wherein said act of fanning out is performed recursively.

139. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each middle switch further comprising at least one link

connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, said method comprising :

checking if all the destination output switches of said multicast connection have available second internal links from at most three middle switches.

140. (new): The method of claim 139 further comprising:

checking if the input switch of said multicast connection has available first internal links to at most said three middle switches.

141. (new): The method of claim 139 further comprising:

repeating said checkings of available second internal links to all said destination output switches for all the other combinations of at most three middle switches.

142. (new): The method of claim 139 further comprising:

repeating said checkings of available first internal links for all the other combinations of at most three middle switches.

143. (new): The method of claim 139 further comprising:

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setting up each of said connection from its said input switch to its said output switches through at most said three middle switches, selected by said checkings, by fanning out said multicast connection in its said input switch into at most said three middle stage switches;

144. (new): The method of claim 139 wherein any of said acts of checking and setting up are performed recursively.

145. (new): A method of setting up a multicast connection through a three-stage network, said method comprising:

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fanning out at most three times in an initial stage,

and fanning out any number of times in each of the remaining stages,

wherein said three-stage network includes said remaining stages and said initial stage.

146. (new): The method of claim 145 further comprising:

repeating said acts of fanning out with a plurality of portions of each said stages.

147. (new): The method of claim 145 further comprising:

recursively performing said act of fanning out.

148. (new): The method of claim 145 wherein:

a remaining stage immediately following said initial stage comprises internal links that are at least three times the total number of inlet links of said initial stage.

149. (new): The method of claim 145 wherein:

said initial stage comprises a plurality of first switches, and plurality of inlet links connected to each said first switch; and

a remaining stage immediately following said initial stage comprises a plurality of second switches, that are at least three times the number of inlet links of each first switch and each second switch comprises a plurality of first internal links at least equal in number to the number of first switches in said initial stage.

said multicast connections having a fan-out of one or more in said middle stage.

150. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to each output switch for a total of at least r_2 second internal links, for $x \geq 1$,

said network further is always capable of setting up said connection by never changing path of a previously set up multicast connection, and the network is hereinafter "strictly nonblocking network", where $m \geq x * n_1 + n_2 - 1$, for $x \geq 2$.

151. (new): The network of claim 150 wherein each multicast connection from an inlet link passes through at most x middles switches, and said multicast connection further passes to a plurality of outlet links from said at most x middle switches.

152. (new): The network of claim 150 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

153. (new): The network of claim 150 wherein said r_1 input switches and r_2 output switches are the same number of switches.

154. (new): The network of claim 150 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then $m \geq (x+1) * n - 1$.

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155. (new): The network of claim 150,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

156. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, for $x \geq 2$, said method comprising:

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receiving a multicast connection at said input stage;

fanning out said multicast connection in said input stage into at most x middle switches to set up said multicast connection to a plurality of output switches among said

r_2 output switches, wherein said plurality of output switches are specified as destinations of said multicast connection, wherein first internal links from said input switch to said at most x middle switches and second internal links to said destinations from said at most x middles switches are available,

wherein said act of fanning out is performed without changing any existing connection to pass through another middle switch.

157. (new): The method of claim 156 wherein said act of fanning out is performed recursively.

158. (new): A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each of said r_2 said output switches through r_2 second internal links, for $x \geq 2$, said method comprising:

checking if all the destination output switches of said multicast connection have available second internal links from at most x middle switches.

159. (new): The method of claim 158 further comprising:

checking if the input switch of said multicast connection has an available first internal links to said at most x middle switches.

160. (new): The method of claim 158 further comprising:

repeating said checkings of available second internal links to all said destination output switches for all the other combinations of at most x middle switches.

161. (new): The method of claim 158 further comprising:

repeating said checkings of available first internal links for all the other combinations of at most x middle switches.

162. (new): The method of claim 158 further comprising:

setting up each of said connection from its said input switch to its said output switches through at most x said middle switches, selected by said checkings, by fanning out said multicast connection in its said input switch into at most said x middle stage switches.

163. (new): The method of claim 158 wherein any of said acts of checking and setting up are performed recursively.

164. (new): A method of setting up a multicast connection through a three-stage network, for $x \geq 2$, said method comprising:

fanning out at most x times in an initial stage,

and fanning out any number of times in each of the remaining stages,

wherein said three-stage network includes said remaining stages and said initial stage.

165. (new): The method of claim 164 further comprising:

repeating said acts of fanning out with a plurality of portions of each of said stages.

166. (new): The method of claim 164 further comprising:

recursively performing said act of fanning out.

167. (new): The method of claim 164 wherein:

a remaining stage immediately following said initial stage comprises internal links that are at least x times the total number of inlet links of said initial stage.

168. (new): The method of claim 164 wherein:

said initial stage comprises a plurality of first switches, and plurality of inlet links connected to each said first switch; and

a remaining stage immediately following said initial stage comprises a plurality of second switches that are at least x times the number of inlet links of each first switch and each second switch comprises a plurality of first internal links at least equal in number to the number of first switches in said initial stage.

169. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \le d \le r_2$,

wherein $m \ge \sum_{i=1}^{P}(x_i * a_i + n_1 - 1)$, where $\sum_{i=1}^{P} a_i = n_1 + n_2$ and $x_1, x_2, ..., x_p \ge 1$;

wherein, for $1 \le i \le p$, multicast connections from a_i inlet links of each input switch pass through at most x_i middles switches,

said network further is capable of setting up said connection by never changing path of a previously set up multicast connection, and the network is hereinafter "strictly nonblocking network", where $x_1, x_2, ..., x_p \ge 2$.

170. (new): The network of claim 169 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

171. (new): The network of claim 169 wherein said r_1 input switches and r_2 output switches are the same number of switches.

172. (new): The network of claim 169 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$.

173. (new): The network of claim 169,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

174. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \le d \le r_2$,

said network further is always capable of setting up said connection by never changing path of a previously set up multicast connection, and the network is hereinafter "strictly nonblocking network", where m is a minimum of at least $2 * n_1 + n_2 - 1$.

175. (new): The network of claim 174 wherein each multicast connection from an inlet link passes through at most one or two middles switches, and said multicast connection further passes a plurality of outlet links from said at most two middle switches.

176. (new): The network of claim 174 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

177. (new): The network of claim 174 wherein said r_1 input switches and r_2 output switches are the same number of switches.

178. (new): The network of claim 174 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then m is a minimum of at least $3 * n - 1$.

179. (new): The network of claim 174,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

180. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \le d \le r_2$,

said network further is always capable of setting up said connection by never changing path of a previously set up multicast connection, and the network is hereinafter "strictly nonblocking network", where m is a minimum of at least $3 * n_1 + n_2 - 1$.

181. (new): The network of claim 180 wherein each multicast connection from an inlet link passes through at most three middles switches, and said multicast connection further passes a plurality of outlet links from said at most three middle switches.

182. (new): The network of claim 180 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

183. (new): The network of claim 180 wherein said r_1 input switches and r_2 output switches are the same number of switches.

184. (new): The network of claim 180 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then m is a minimum of at least $4 * n - 1$.

185. (new): The network of claim 180 ,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

186. (new): A network having a plurality of multicast connections, said network comprising:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches, and $N_1 = n_1 * r_1$;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches, and $N_2 = n_2 * r_2$; and

a middle stage comprising m middle switches, and each middle switch comprising at least one link connected to each input switch for a total of at least r_1 first internal links; each middle switch further comprising at least one link connected to at most d output switches for a total of at least d second internal links, wherein $1 \le d \le r_2$, for $2 \le x \le r_2$,

said network further is always capable of setting up said connection by never changing path of a previously set up multicast connection, and the network is hereinafter "strictly nonblocking network", where $m \ge x * n_1 + n_2 - 1$.

187. (new): The network of claim 186 wherein each multicast connection from an inlet link passes through at most x middles switches, and said multicast connection further passes a plurality of outlet links from said at most x middle switches.

188. (new): The network of claim 186 comprising a controller in communication with said input, output and middle stages to set up said multicast connection.

189. (new): The network of claim 186 wherein said r_1 input switches and r_2 output switches are the same number of switches.

190. (new): The network of claim 186 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then $m \ge (x+1) * n$.

191. (new): The network of claim 186,

wherein each of said input switches, or each of said output switches, or each of said middle switches further recursively comprise one or more networks.

192. (new): A network comprising a plurality of input subnetworks, a plurality of middle subnetworks, and a plurality of output subnetworks, wherein at least one of said input subnetworks, said middle subnetworks and said output subnetworks recursively comprise:

an input stage comprising r_1 input switches and n_1 inlet links for each of said r_1 input switches;

an output stage comprising r_2 output switches and n_2 outlet links for each of said r_2 output switches; and

a middle stage, said middle stage comprising m middle switches, and each middle switch comprising at least one link (hereinafter "first internal link") connected to each input switch for a total of at least r_1 first internal links, each middle switch further comprising at least one link (hereinafter "second internal link") connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, and for $x \leq 2$;

wherein each multicast connection from an inlet link passes through at most x middle switches, and said multicast connection further passes to a plurality of outlet links from said at most x middle switches.

Table 1 below shows the correspondence of the Claims between the current patent application and Amendment A.

Table 1 Correspondence of Claims between the patent application 09/967106 and Amendment A

09/967,106	AMENDMENT A		09/967,106	AMENDMENT A
1	110			142 added
2-3	Merged with 110		42-43	143-144
	111 (separated from 110)		44	145
4-6	112-114		45	Merged with 145
7	Deleted		46-49	146-149
8	115		50-52	Deleted
9	116		53	150
10	Merged into 116		54-55	Merged with 150
11	117			151 (separated from 150)
12-16	118-122		56-58	152-154
	123 added		59	Deleted
17-18	124-125		60	155
19	126		61	156
20	Merged with 126		62	Merged into 156
21-24	127-130		63	157
25-27	Deleted		64-66	158-160
28	131			161 added
29-30	Merged with 131		67-68	162-163
	132 (separated from 131)		69	164
31-33	133-135		70	Merged with 164
34	Deleted		71-74	165-168
35	136		75-77	Deleted
36	137		78	169
37	Merged into 137		79	Merged with 169
38	138		80-82	170-172
39-41	139-141		83	Deleted

09/967,106	AMENDMENT A		09/967,106	AMENDMENT A
84	173		96-98	182-184
85	174		99	Deleted
86-87	Merged with 174		100	185
	175 (separated from 174)		101	186
88	176		102-103	Merged with 186
89-90	177-178			187 (separated from 186)
91	Deleted		104-106	188-190
92	179		107	Deleted
93	180		108	191
94-95	Merged with 180		109	192
	181 (separated from 180)			

A GUIDE TO GO THROUGH THE CLAIMS IN AMENDMENT A:

Applicant also provides the following breakdown of the claims to go through the claims easily:

1) Claims with fan-out of at most two in the first stage:

Claims 110-115: 3-stage network.

Claims 116-117: Key method.

Claims 118-125: Detailed steps method.

Claims 126-130: Key method in a generic network.

2) Claims with fan-out of at most three in the first stage:

Claims 131-136: 3-stage network.

Claims 137-138: Key method.

Claims 139-144: Detailed steps method.

Claims 145-149: Key method in a generic network.

3) Claims with fan-out of at most any x (>= 2) in the first stage:

Claims 150-155: 3-stage network.

Claims 156-157: Key method.

Claims 158-163: Detailed steps method.

Claims 164-168: Key method in a generic network.

4) Claims with fan-out of arbitrary mix of at most any x (>= 2) in the first stage:

Claims 169-173: 3-stage network.

5) Claims with fan-out of at most two in the first stage:

Claims 174-179: 3-stage network for a subset of output switches.

6) Claims with fan-out of at most three in the first stage:

Claims 180-185: 3-stage network for a subset of output switches.

7) Claims with fan-out of at most any x (>= 2) in the first stage:

Claims 186-191: 3-stage network for a subset of output switches.